RESEARCH HIGHLIGHT

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DUCT LEAKAGE TESTS IN A SMALL DIAMETER DUCTING SYSTEM

INTRODUCTION

The majority of Canadian houses have forced air heating systems, which often incorporate the distribution of cooling air in summer as well. The ducts typically are bare sheet metal provided in a variety of sizes and shapes, depending upon the application. Duct sealing has never been a priority in Canadian low-rise heating systems. As most Canadian ducting systems are within the house envelope, there is no significant loss of energy due to incidental leakage, although inefficient ducting can lead to room comfort issues. Measurements in the early nineties (http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/03-131-e.pdf) showed that somewhere between 25 per cent and 75 per cent of the air moved by the furnace circulation fan actually exited at the grilles, with the remainder being lost through ductwork seams, junctions, elbows, etc.

One alternative to traditional sheet metal ducting is the use of small circular ducts with higher velocities. These can be easier to fit into internal wall cavities. Potential drawbacks include increased noise due to higher airflow velocities, the fan energy required to propel airflow through the more resistive smaller ducts, and the current need for an engineered design of these systems. These smaller systems should be less prone to duct leakage, due to the use of more airtight components and tighter junctions. However, there is little or no data on the leakage rate of these systems. As part of a research project on zoned cooling, CMHC tested five houses with small diameter ducting to determine the range of leakiness of these systems.

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RESEARCH PROGRAM

In the Toronto, Ontario vicinity five houses with existing small diameter ducting were tested by an independent consultant. The houses had been built within the last five years by various contractors. The same proprietary ducting system had been installed in all five houses. Therefore, results are specific to that system. Leakage was tested in three different ways:

1. Using a commercially available duct leakage testing device to pressurize and measure leakage.
2. Measuring the airflow at the air handler with a proprietary duct airflow testing device, and comparing this flow to the sum of flows at the individual grilles by a commercial capture hood.
3. Same method as no.2 but using a capture hood connected to a flow station measurement system which is used for heat recovery ventilator commissioning.

There are significant differences in these techniques. The duct leakage testing device, the DuctBlaster ™, performs an airtightness test of the ducts at a standard and mostly uniform pressure, with the grilles sealed. It has a fan flow measurement accuracy of +/- 3 per cent. This equipment is used for testing of ducts to ensure leakage criteria meet various codes or standards. The air handler measurement device, the TrueFlow ™, has stated accuracy of +/- 7 per cent. There will also be inaccuracies in measuring and adding the flows at the individual grilles. Comparing the sum of these flows to the flow at the air handler can result in an error rate exceeding 10 per cent. The calculations from the last two tests must therefore be considered a rough estimate of leakage, rather than a precise measurement.

Note that all five houses were provided by a single manufacturer of 75 mm ducting and may not represent the full range of installation quality. However, the houses were built long before anyone envisioned a duct leakage research project, so they were not built with an exceptional degree of care.

RESULTS

This system of small diameter ducting proved to be of much tighter construction than the more common sheet metal ducts described above. Here are the results of the testing:

House no.	Measured airflow at furnace	% leakage		
	(L/s)	DuctBlaster	Velometer	Flow station
1	521	15	11	10
2	424	5	4	3
3	448	4	2	3
4	542	4	3	5
5	378	9	7	6

House no. 1 had an observable leak at the junction where the supply plenum joined the air handler. It was measured with this leakage unrepaired, but likely represents an anomalous situation. Without taking that data into consideration, the ducting systems have leakages in the 3-9 per cent range, depending upon how the leakage was calculated. All three systems achieved comparable results. In most cases the DuctBlaster method was marginally higher than the other two measurement techniques.

These houses were mass-produced, they were not intended to meet duct leakage criteria. Despite that, the results would meet, or come close, to most of the duct leakage standards in place in the U.S. at the time of the 2005 testing. Here is a short list:

1. Energy Efficient Builders' Association
   <10 per cent of system flow
2. California Energy Commission
   < 6 per cent of system flow
3. Engineered for Life Program (top rating)
   < 5 per cent of system flow
4. Proposed EPA ENERGY STAR Ducts
   < 8 per cent of system flow

There have been numerous studies on metal duct sealing in the U.S. It is clear from the standards above that it is possible—with diligent installation—to reduce the leakage level of regular metal ducts to the level observed for small diameter ducting. However, the data from Canadian research shows that the small diameter ducting can be more airtight than the metal ducts in a typical installation.

IMPLICATIONS FOR THE HOUSING INDUSTRY

This limited study confirms what was suspected: small diameter ducting (at least the type tested) can be intrinsically more airtight than the metal ducting, and leakage from these ducts will be minimal. For situations where it is critical to reduce duct leakage, small diameter systems can offer an advantage. Designers of heating systems circulated through small diameter ducting, of the type and quality tested, do not have to compensate for leakage losses from the ducts. This could be particularly important for cooling the top floors of multi-storey houses.

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Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

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